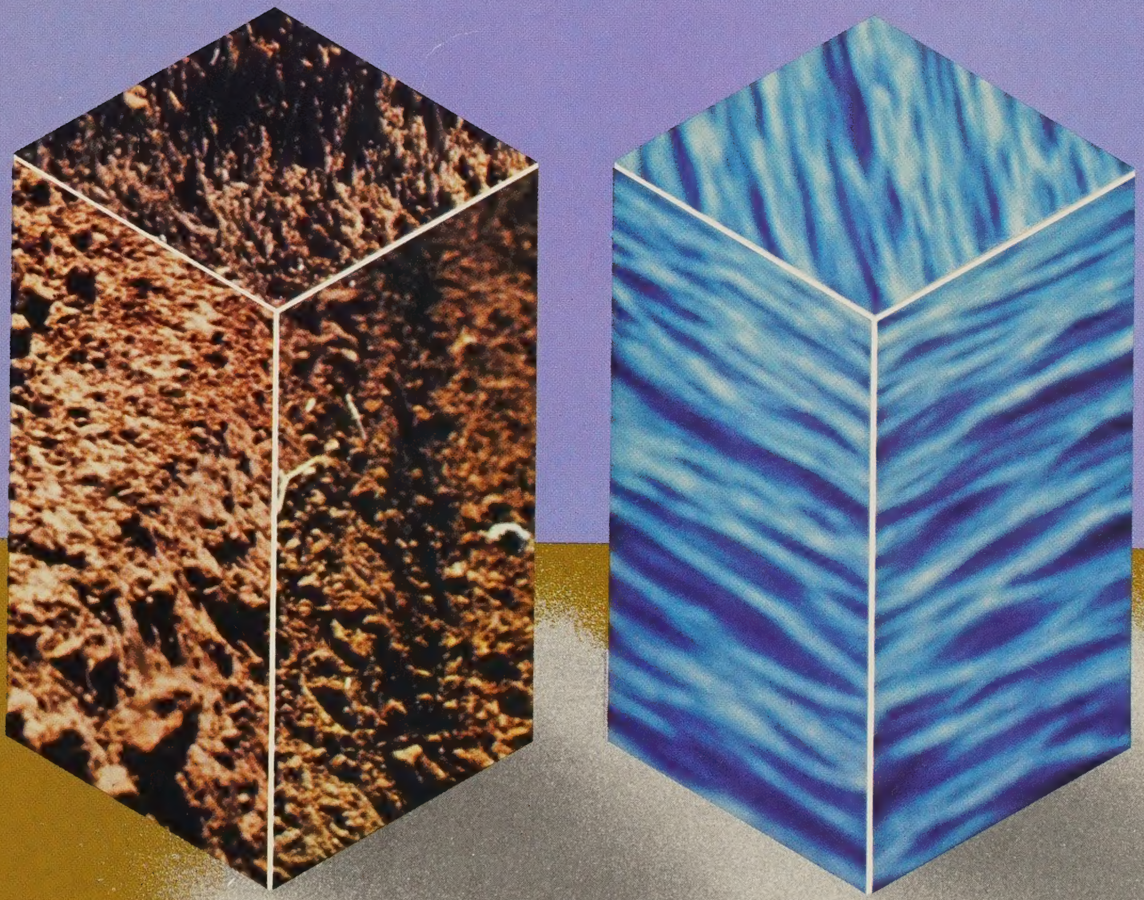
United States
Department of
Agriculture

Soil
Conservation
Service

America's Soil and Water: Condition and Trends



Introduction

A large part of the true wealth of the United States is its soil and water. If their value is not yet fully appreciated, it is because we have had enough soil, and usually enough water, to grow all the food and fiber we needed, and then some. Most years, we have supplied ourselves in abundance, fed the people of many foreign nations, and still had enough left over to create a worrisome surplus.

But our soil and water resources are not without limit. They are finite and vulnerable, as we have been reminded on occasion by gullies, exhausted land, dust storms, and drought. Despite these periodic lessons, however, we continue to waste these resources, diminish them, abuse them.

This book is about soil and water on two-thirds of our land — the rural nonfederal land of the United States where our crops are grown, where much of our livestock is pastured and grazed, and where our private forests are managed. Many of the facts were supplied by the National Resource Inventories, begun by USDA's Soil Conservation Service in 1977. Other significant findings came from the Water Resources Council, U.S. Geological Survey, and other responsible agencies. Many were published in more detail in the *Appraisal, Part I,* of the Department of Agriculture's response to the Soil and Water Resources Conservation Act of 1977.

The story told by the text and maps and charts and graphs about our basic resources is not a reassuring one. It makes it clear that we must mend our ways, replacing waste and carelessness with conservation. But if the story is sobering, it is also far from hopeless. The technology of soil and water conservation, while never complete, is more than adequate today to reduce much soil erosion to acceptable limits, to increase rangeland and forest productivity, and to improve irrigation efficiency and water quality.

Several approaches and programs that attempt to deal with these resource problems are mentioned briefly in this book; there are several others. New approaches — local, state, regional, federal — are presently being studied, proposed, and discussed. We still have time. For a little while.

Issued December 1980

Land use in America . . . and how it is changing

Roughly two-thirds of the land area of the United States — about 1.5 billion acres — is nonfederal land. It encompasses private land, including farms and ranches, Indian lands, and land belonging to state and local governments.

The use of nonfederal lands is far from static. We continue to grow more crops on fewer acres, year after year.

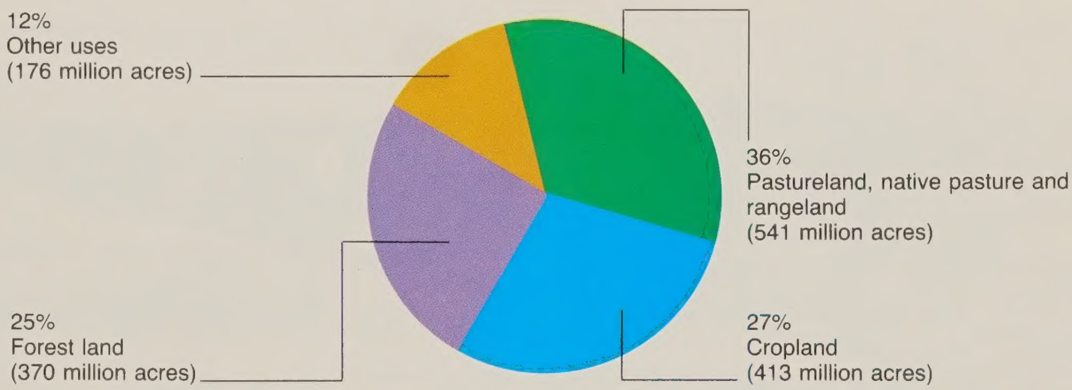
Between 1958 and 1977, cropland acreage fell 8 percent, but we produced more food and fiber per acre and in total. Forest land acreage also decreased, while pasture and rangeland increased and much rural land was paved over.

Rural land use shifts back and forth. Between 1967 and 1975, millions of acres went from crops to pasture, and millions more from pasture to crops. Trees were felled on 11 million acres to make way for cropland, while millions of acres of cropland reverted to forest.

Unless otherwise stated, the data in this book exclude Alaska, because of the unique land use pattern in that state.

Use of Nonfederal Land

Includes United States, Puerto Rico, and Virgin Islands. Excludes Alaska.

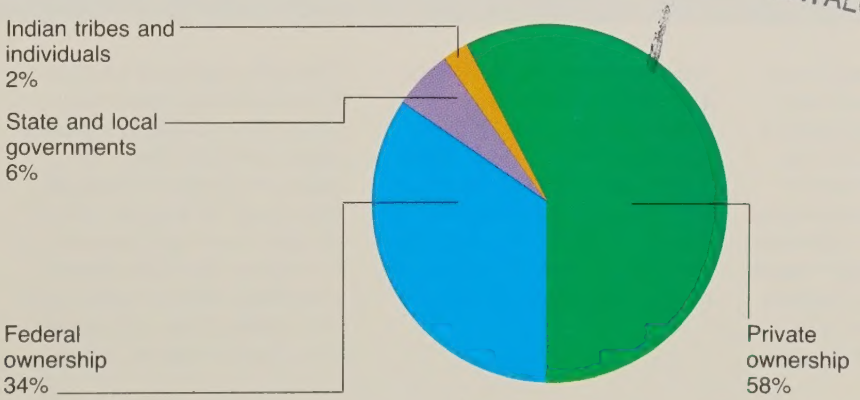


Trends in Land Use

Includes United States, Puerto Rico, and Virgin Islands. Excludes Alaska.

	1958 (Millions of Acres)	1977 (Millions of Acres)	Percent Changed
Cropland	448	413	− 8
Pastureland, native pasture, and rangeland	485	541	+12
Forest land	453	370	−18
Urban land (over 10 acres)	51	90	+76
Small areas of open water	7	9	+29
Other	60	77	+27
Total	1,504	1,500	

Land Ownership in the United States



Determining the land's potential: a quick guide

There are thousands of different soil types in the United States, and detailed information is available on the management of each. Many of these data are published on a county basis in soil surveys, available from USDA's Soil Conservation Service.

A less precise but simpler guide to the land's ability to grow crops divides the rural landscape into eight classes, with Class I the best for growing crops and Class VIII unsuitable for growing any crops at all. These land capability groupings are widely used by soil conservationists and farmers.

Each capability class has several subclasses to identify specific limitations on use: the letter *e* stands for erosion risk; *w*, for wetness; *s*, for shallow, or root zone problems, and *c*, for climatic limitations. Land identified as Class IIe, for example, would be suitable for growing crops if adequate measures were installed to reduce or prevent soil erosion.

Class I soils have few limitations that restrict their use. Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices. Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both. Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both. Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife. Class VI soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture or range, woodland, or wildlife. Class VII soils have very severe limitations that make them unsuitable for cultivation and that restrict their use largely to pasture or range, woodland, or wildlife. Class VIII soils and landforms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

Classes of land . . . and how we use them

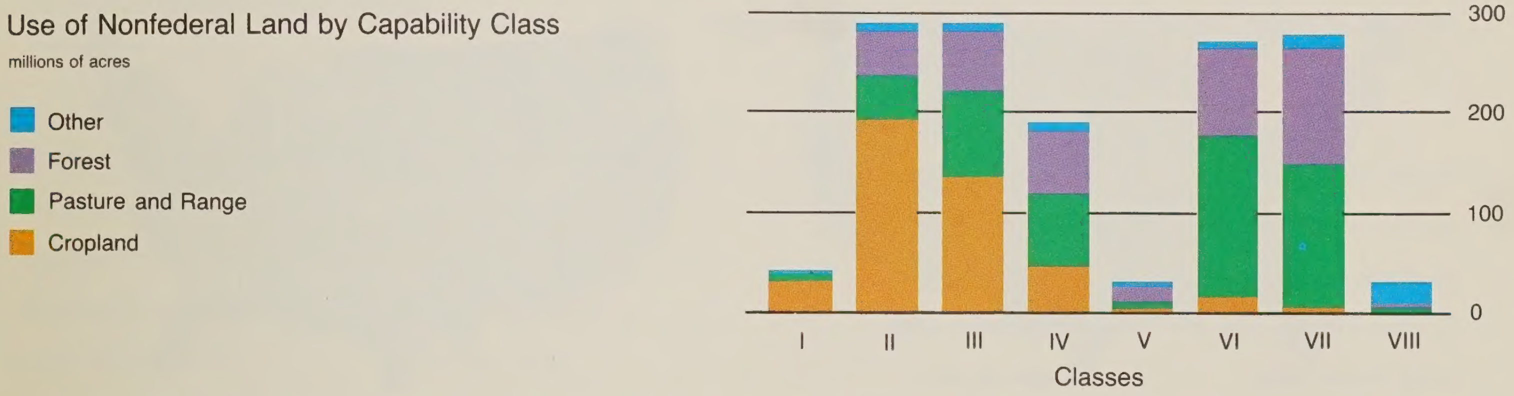
On the whole, farmers are making rational use of their farmland. Almost all of America's Class I land, with soils that are level, deep, well drained, and easy to work, is being used to grow crops. The larger Classes II and III supply the majority of our cropland, although they generally require the application of conservation measures.

There are also about 50 million acres of cropland in Class IV. Soil conservation on this land is often expensive and difficult to apply and maintain. But, as one Missouri farmer said, "Sure, I'm cropping Class IV land, but it's all I've got."

Thanks in part to the overall decline in cropland acreage, the quality of land used for farming has improved during the past three decades. More of our Class I-III land is being used for crops than formerly, and only half as much of our Class V-VIII land. The proportion of Class IV land used for crops edged up to 11 percent in 1958 and has stayed there ever since.

Use of Nonfederal Land by Capability Class

millions of acres



Trends in Use of Land for Cropland

Use as Cropland by Capability Class	Year 1950	1958	1967	1977
I-III	82%	83%	84%	85%
IV	10%	11%	11%	11%
V-VIII	8%	6%	5%	4%
Total	100%	100%	100%	100%

Our best cropland . . . and what we grow there

Fortunately for our standard of living and foreign trade balance, there is more high quality land available for agriculture in the United States than in any other country in the world.

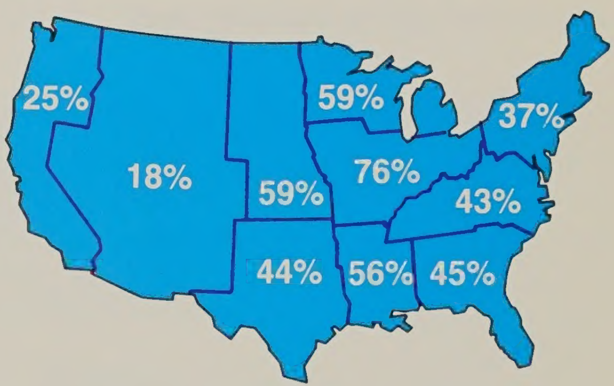
The largest acreage of high quality soils for farming is located in the Corn Belt, where more than three-fourths of the acreage is suitable for continuous cultivation. In the Lake States, Northern Plains, and Delta States, more than half the acreage can be cultivated continuously.

Good farmland, of course, is but one factor in America's unexcelled farm production. The application of research and technology have helped increase the yield per acre about 1.6 percent per year during the last half century, although this rate appears to be slowing.

Despite the diversity of the American landscape and diet, we use the bulk of our cropland to produce only four major crops — corn, wheat, hay, and soybeans — and all but hay are major export crops.

Percent of Good Cropland in Each Farm Production Region

Pacific 25%	Corn Belt 76%
Mountain 18%	Delta States 56%
Northern Plains 59%	Northeast 37%
Southern Plains 44%	Appalachian 43%
Lake States 59%	Southeast 45%



Important Crops Grown

millions of acres planted in 1977

Turnips are grown on Class I cropland in Bibb County, Georgia. Prime farmland like this is being paved over at the rate of 1 million acres a year.

Prime farmland is slipping away

Prime farmland is our *best* farmland. It produces high crop yields with the least damage to the soil. In 1977, there were 346 million acres of prime farmland remaining in the United States. This year, there are fewer acres left, and next year, there will be fewer still.

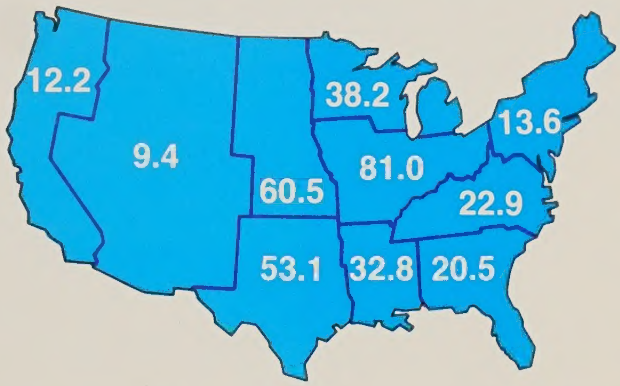
Of 3 million acres of rural land lost to agriculture each year, about 1 million acres are prime farmland. The fact that it is level and well drained also makes it attractive to builders and developers. Each year, more than 800,000 acres of our best farmland become housing tracts, highways, airports, industrial sites, parking lots. Nearly 200,000 acres are covered by water for manmade lakes and reservoirs.

The National Agricultural Lands Study has predicted that at current rates of land loss, Florida and two other states will lose nearly all their prime farmland by the turn of the century. So far, however, successful attempts by state and local governments to stem the loss of prime farmland have been few and far between.

Prime Farmland in Each Region

millions of acres

Pacific 12.2
Mountain 9.4
Northern Plains 60.5
Southern Plains 53.1
Lake States 38.2
Corn Belt 81.0
Delta States 32.8
Northeast 13.6
Appalachian 22.9
Southeast 20.5

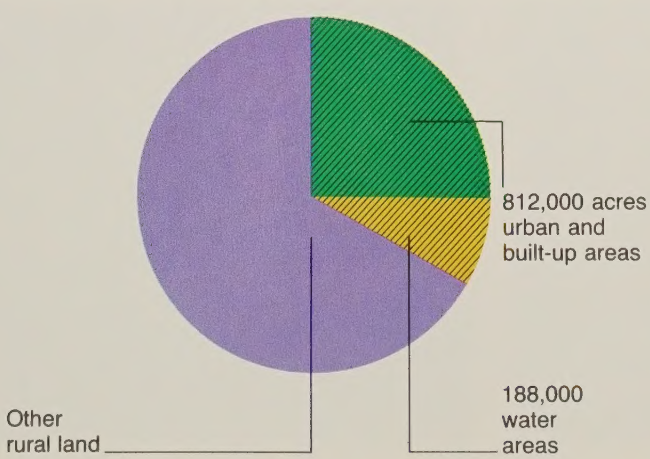


Use of Prime Farmland in 1977

Land Use	Acres (millions)	Percent
Cropland	230	67
Native pasture and Pastureland	40	12
Rangeland	22	6
Forest land	42	12
Other land	11	3
Total	345	100

3 million acres rural land lost to nonfarm purposes each year

1 million acres prime farmland



Where can we find new cropland?

As population and export demand increase, it is likely that at some point in the future, the United States will begin planting more cropland each year, not less. Production of grain for gasohol could hasten that day. When that happens, how much cropland reserve will remain?

According to SCS National Resource Inventories, in 1977 there were about 127 million acres with a high or medium potential for conversion to cropland. This is in addition to our current cropland base of 413 million acres.

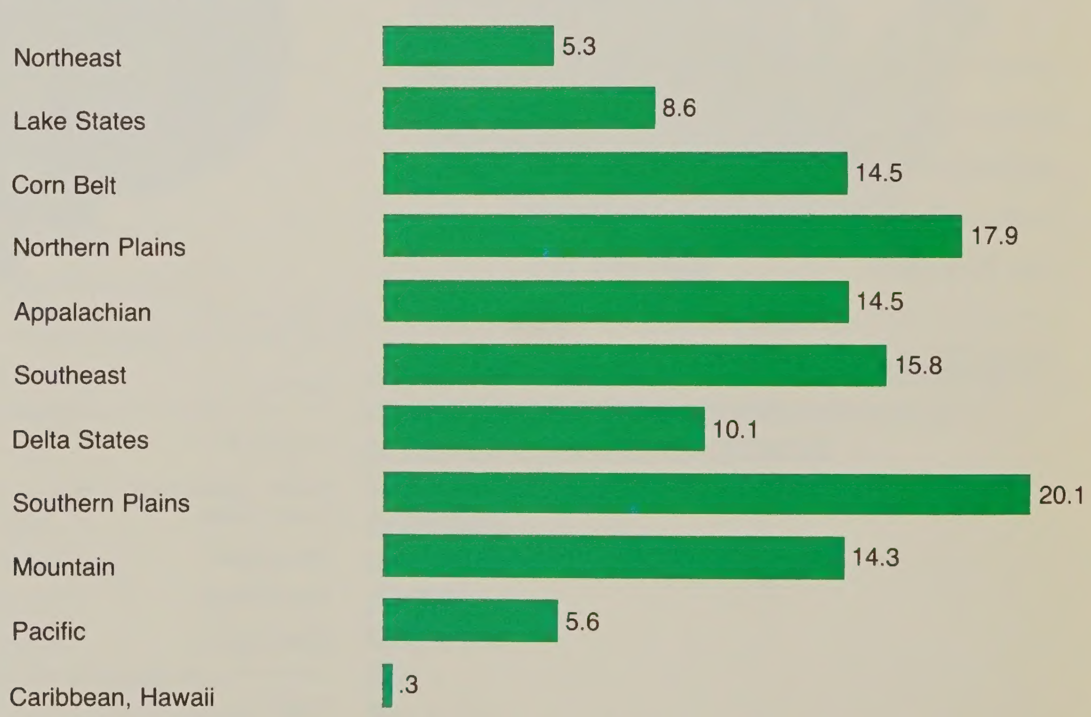
This potential cropland is not standing idle, waiting for the plow. It is already in other uses; three-fourths is grazing land and one-fourth is in forest. Conversion to cropland would mean a significant loss in forage and wood-producing areas and, in some places, wildlife habitat.

About 75 percent of the potential cropland has one or more soil limitations that would have to be dealt with before conversion to crops.

Potential Cropland in Each Region with High or Medium Potential (127 million acres)

Land is now in other uses, including forests and range.

millions of acres



Most new cropland to meet future demands for food and fiber will have to come from land now in pasture or forest.

Not all soils are right for cultivation

Most soils can't be, or shouldn't be, used for growing crops. That includes the soils making up about two-thirds of the nonfederal land of the United States.

Many soils have too much slope. If cultivated for row crops, topsoil would wash downhill at unacceptable rates.

Millions of acres of soil are too wet for crops, either from too high a water table or occasional flooding. Other soils are too shallow to permit proper root development, or too stony, or too dry.

In many parts of the West, soils are too salty or sodic to grow crops.

Most of America's nonfederal land has one or more of these limitations for growing crops.

Commented a soil scientist: "When you examine all the reasons why so many soils can't grow crops, you appreciate more than ever the value of first-class farmland."

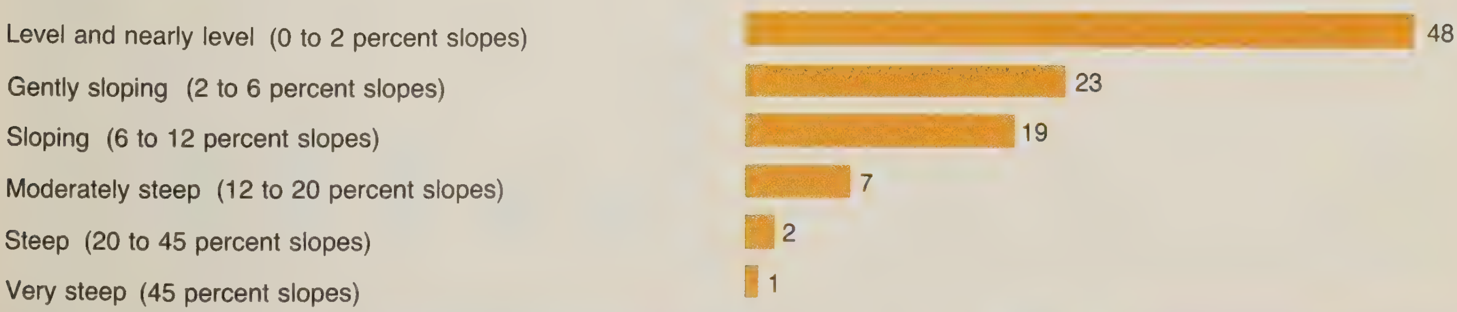
Condition of Rural Soils

A soil may appear under more than one category

Condition	Million Acres	Percent
Level	420	29
Sloping	1,010	71
Wet	265	19
Droughty	362	25
Flood Prone	175	12

How Steep Is Our Cropland?

percent of cropland



Examples (left to right) of soils that are shallow and stony, highly erodible, and droughty.

Sheet and rill erosion robs farms of soil

Some soil erosion from the action of water is inevitable. It becomes a threat to productivity only when the annual rate of erosion exceeds the rate at which new soil can be created. On most cropland, pasture, and forest, an erosion rate of 4 or 5 tons per acre is "acceptable" because the eroded soil is replaced through natural processes.

There are several kinds of erosion from water. *Sheet erosion* is the removal of a fairly uniform layer of soil by rain and runoff. *Rill erosion,* the formation of small channels, is the result of surface runoff. When a rill gets deeper than 1 foot, it is called a *gully.*

In 1977, more than 2 billion tons of soil were lost through sheet and rill erosion, with critical losses in the Corn Belt, Delta States, and west Tennessee.

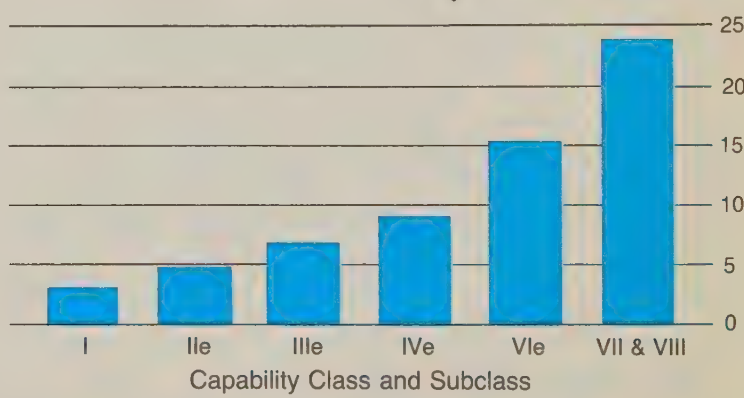
According to early estimates, gully erosion stole an additional 450 million tons of soil, with streambank and roadside erosion taking even more.

Where Sheet and Rill Erosion is Worst

Sheet and Rill Erosion, by Land Capability Class

Includes average erosion on level and sloping cropland

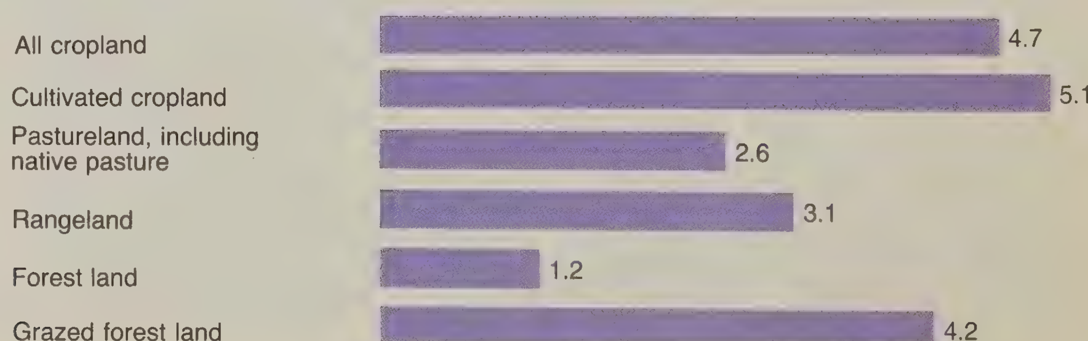
tons/acre/year



Erosion Rates by Land Use

Limited to average annual rates of sheet and rill erosion

Soil loss in tons per acre per year



Some serious erosion areas in the United States

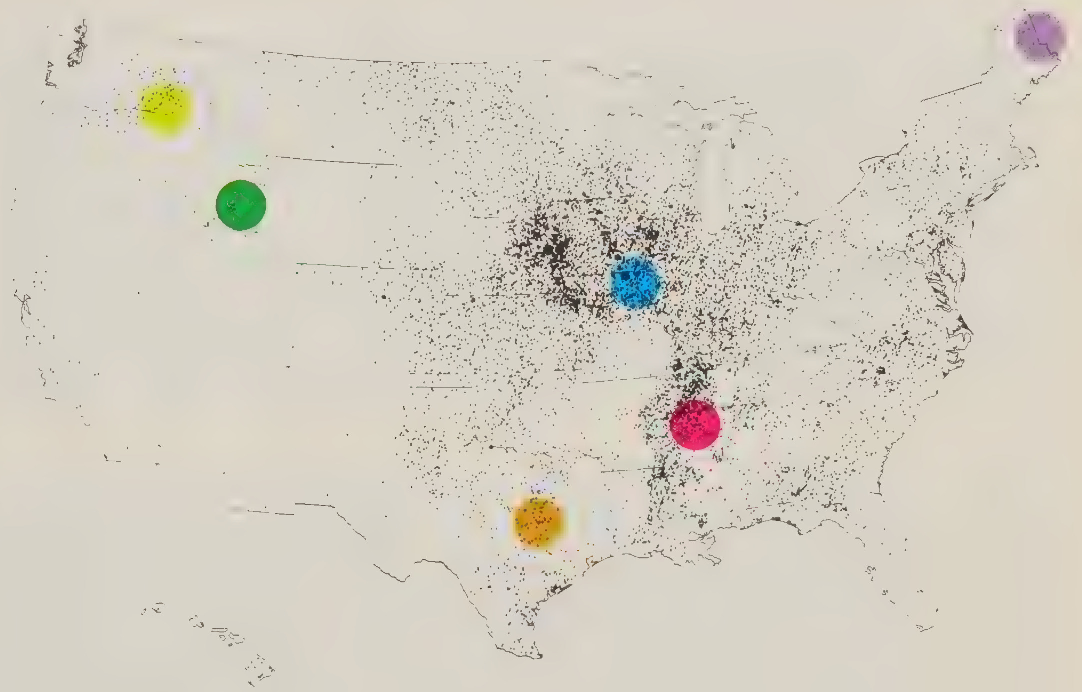
The colored areas on the map below, which show total tons of sheet and rill erosion on cropland, indicate several of the more serious erosion areas in the country.

Cropland Sheet and Rill Erosion: 1977

Total for United States is 2,000,000,000

Data for Alaska not available

1 dot = 250,000 tons



The Palouse, covering parts of Washington, Oregon, and Idaho, is dryfarmed to wheat, barley, peas, and lentils. Most of the cropland is hilly, with slopes of from 15-25 percent. Runoff from melting snow and heavy rains cause erosion of 50 to 100 tons per acre.

Southeastern Idaho cropland is planted in hard red wheat one year and left fallow the next to conserve moisture. Erosion occurs during intense summer rainstorms and even more destructive rains in late winter, when a thawed layer of soil moves downhill over frozen subsoil. Annual erosion may reach 16 tons per acre per year on 35 percent slopes.

Texas Blackland Prairie is an important farming area, with two-thirds of the land in crops, mainly cotton and grain sorghum. Rainfall averages 30 to 50 inches a year on the gently rolling land. Many soils in the area are highly erodible, and erosion is appreciably higher than the national average.

Southern Mississippi Valley, including parts of five states, is about one-third cropland, much of it sloping to steep. The soils are deep, fertile, productive, and erodible. Many row crops are grown without adequate conservation practices, and annual soil losses on much of the land reach 20 tons per acre or more.

The Corn Belt States experience some of the highest erosion rates in the country: in 1977, Iowa cropland lost an average of 9.9 tons of soil per acre; Illinois, 6.7 tons per acre, and Missouri, 10.9 tons per acre.

Aroostook County, Maine, is famous for its potatoes. They are grown on slopes ranging from nearly level to 25 percent. The upper 2 feet of soil have been lost since cultivation began, lowering crop yields. Some sloping fields are losing as much as an inch of soil a year.

Fighting erosion with conservation systems

Fortunately for the future of America's farmlands, many practical systems are available for controlling soil erosion. Two million land users now work through local conservation districts to apply such systems on their farms and ranches. Technical help comes from the professionals of USDA's Soil Conservation Service and cost sharing from SCS and the Agricultural Stabilization and Conservation Service.

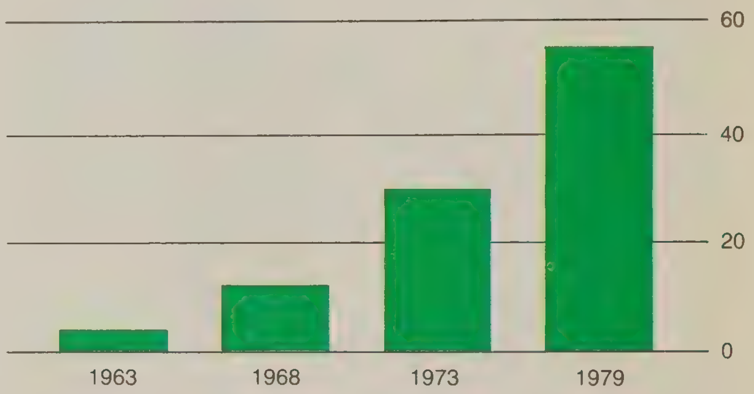
Among the newest and most successful techniques for erosion control are various forms of *conservation tillage,* in which residue from a previous crop is left in the field. In one form — no-till — the land is not even plowed. Conservation tillage also uses less fuel than conventional tillage, but requires much more careful crop management.

But much conservation remains to be applied. SCS found in 1977 that additional conservation treatment was needed on more than half our cropland, two-thirds of our forest land, and three-fourths of our pasture and range.

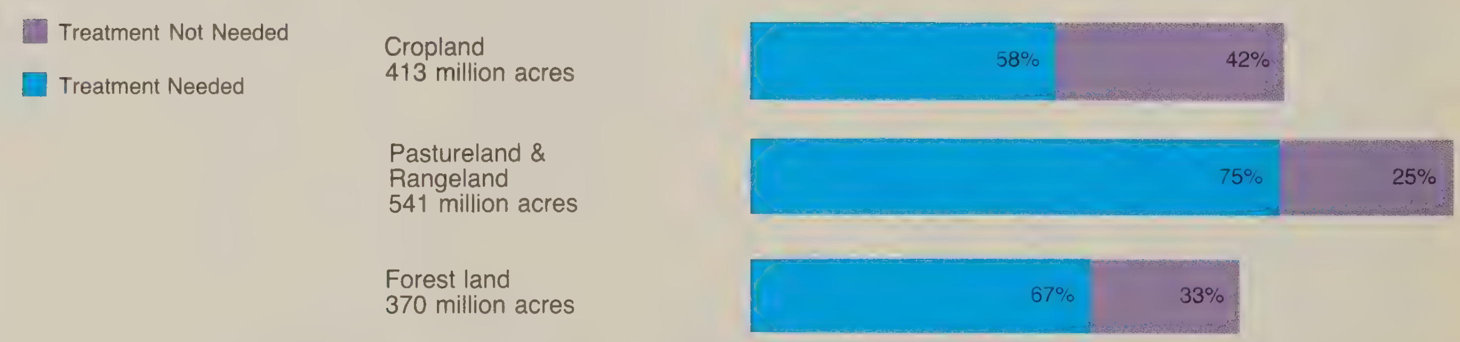
Growth in Conservation Tillage

Includes mulch tillage, no-till, and other reduced tillage techniques

millions of acres



Conservation Treatment Needs in 1977



At right, sloping field is protected from excessive erosion with contour plowing and stripcropping. Far right, conservation tillage systems leave residue from previous crop on the ground to help keep soil from washing.

Even our pastures could be greener

Pastureland is used chiefly to produce domesticated forage plants for livestock. In 1977, there were 116 million acres of pastureland in the United States, a 13.7 percent increase from 1967. Nearly 5 million acres were irrigated.

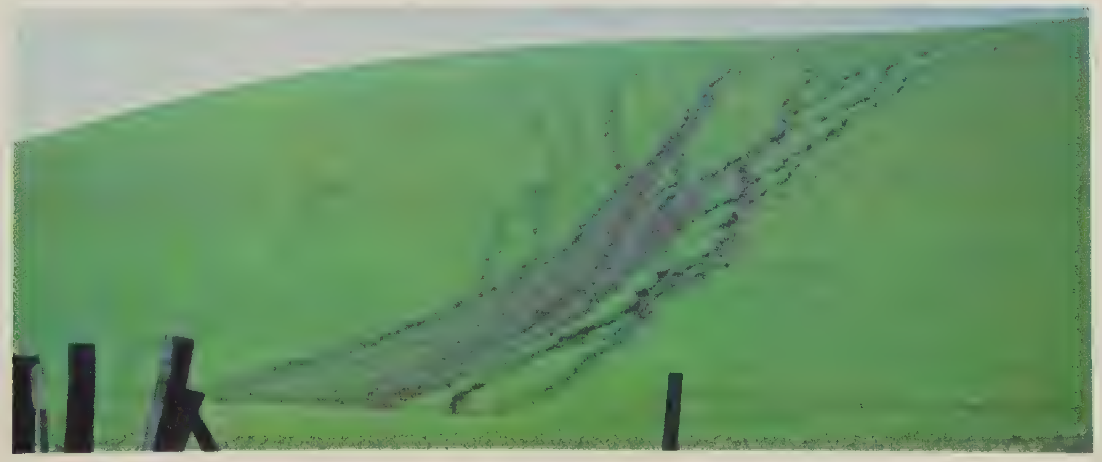
Well-managed pasture land does not suffer much sheet and rill erosion. It is only when it is seriously depleted by drought, overgrazing, close mowing, or insect damage that the soil becomes susceptible to erosion. Even so, in 1977 more than 20 million acres of steep pastureland experienced erosion in excess of 5 tons per acre. Nearly half this acreage should not be used for pasture at all.

Native pasture consists of subclimax plant communities managed for grazing on potential forestland. Some 17.2 million acres are used as native pasture, and those acres in Classes VII and VIII have an erosion rate of 12.6 tons per acre per year. These two categories account for about 93 percent of the sheet and rill erosion on native pasture.

The forage on pastureland is either a perennial grass or a mixture of a grass and one or more legumes.

Native pasture consists of grasses, forbs, grasslike plants, and some shrubs. Brush is a never-ending problem.

Rill erosion appears on sloping California pastureland after heavy rainstorms.



America's rangeland . . . room for improvement

The climax plant cover on rangeland is mostly native grasses, forbs, and shrubs valuable for forage. Except for brush control, rangeland is managed chiefly by regulating the intensity of grazing and the season of use.

As the bar chart below shows, there was substantial improvement in range condition in the 14 years between a 1963 study and 1977. In 1963, only 5 percent of rangeland was rated "excellent"; in 1977, 12 percent. Range rated as "good" went up from 15 percent to 28 percent. Despite these gains, some 60 percent of the range remains in fair or poor condition, and an estimated 32 percent of nonfederal range and native pasture is overgrazed.

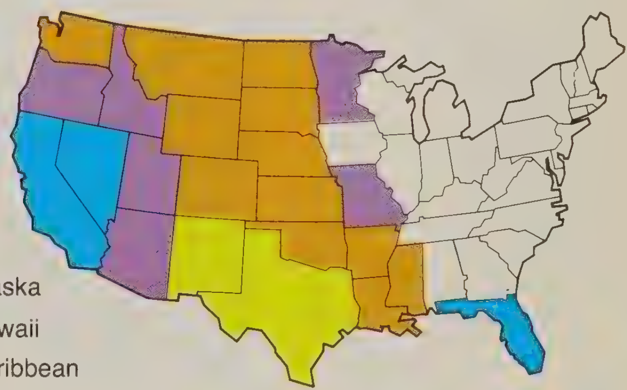
The reduced production caused by degraded range means an annual loss of 6 to 8 hundred million pounds of red meat and a significant amount of wool, mohair, leather, and animal byproducts. Fair and poor rangeland also contributes more sediment to streams and rivers.

Condition of Nonfederal Rangeland

Unshaded states have insignificant amounts of rangeland

Range problems

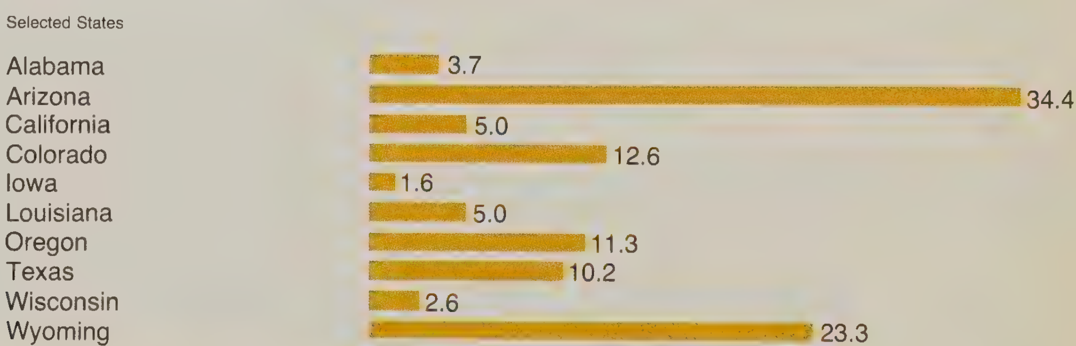
- None To Slight
- Moderate
- Major
- Severe
- No Range Condition Data



- Alaska
- Hawaii
- Caribbean

Land Needed to Graze Each Animal

acres per animal unit



Rangeland varies widely in its ability to support animal units. Here in Colorado, it takes nearly 13 acres of range, on the average, to feed a single head of livestock.

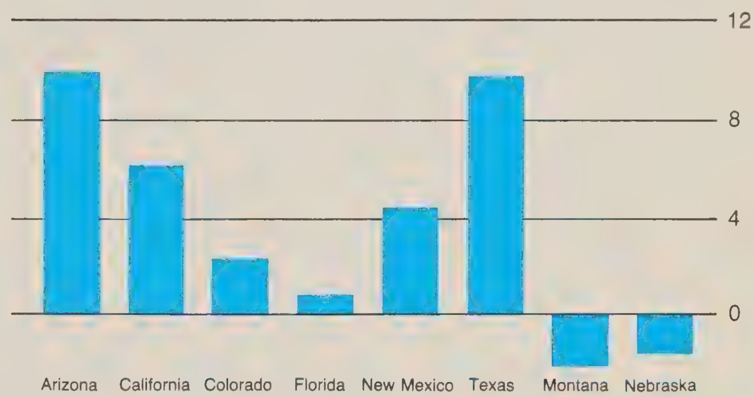
A major problem on rangeland is soil erosion, which occurs readily when the land is misused. Unlike cropland, which can bear an annual soil loss of up to 5 tons per acre, the more fragile rangeland soils can tolerate an erosion rate of no more than 2 tons per acre. In the West, California, Colorado, Arizona, and Texas rangelands experience severe sheet and rill erosion.

Brush is a problem on range when it is so dense that it suppresses the growth of more useful plants. Four range states with severe brush problems are Florida, Oklahoma, Wyoming, and Texas. In 1977, the acreage of brush was increasing in 26 states and density of brush in 20 states. Range management can help reduce brush density but not the total acreage, since eradication has proved unfeasible.

Total acreage of rangeland in the United States has increased in the past two decades, partly from conversion from unneeded cropland and partly from reclassification of some lands from noncommercial forest to rangeland.

Changes in Amount of Nonfederal Rangeland, 1967-77

millions of acres

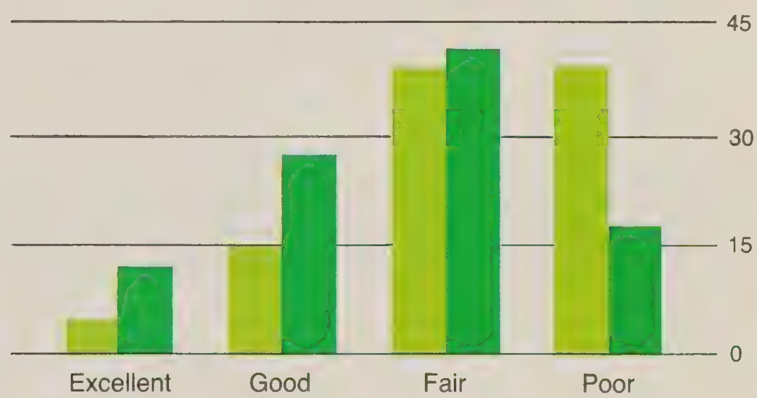


Changing Condition of Nonfederal Rangeland

percent

1963

1977



Managed rangeland at left of fenceline contrasts sharply with overgrazed land on right.

Great Plains Conservation Program: a regional approach

The region known as the Great Plains includes important grazing lands and cropland, including vast acreages of wheat. Located in parts of 10 states, it is an area of light and fragile soils, relatively low rainfall, and periodic drought and dust storms. It was once known as the Great American Desert.

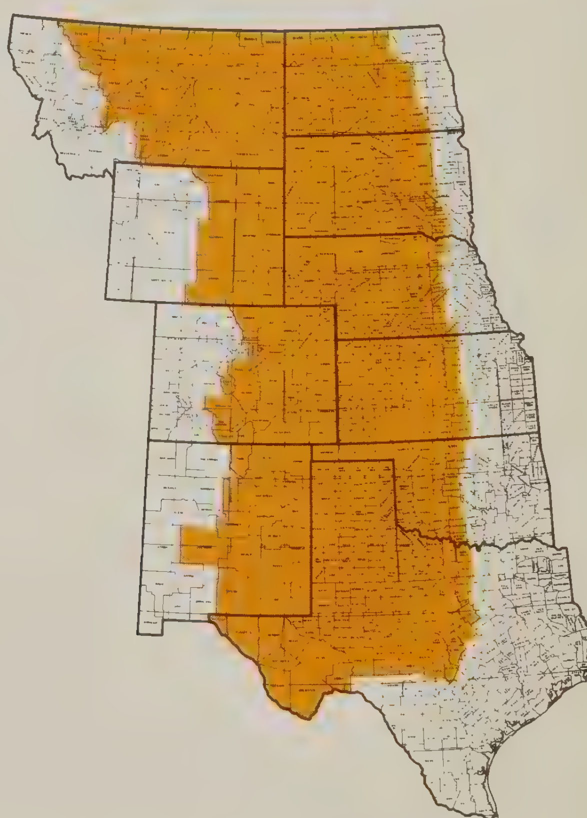
In 1956, the Congress established the Great Plains Conservation Program to help stabilize the agriculture and economy of this vast area.

Under the Program, a participating land owner or operator—

- Works out a conservation plan and schedule;
- Contracts with USDA to apply all the conservation work in from 3 to 10 years;
- Gets technical help from the Soil Conservation Service as needed, and
- Receives from the federal government 50 to 80 percent of the cost of each conservation step as he completes it.

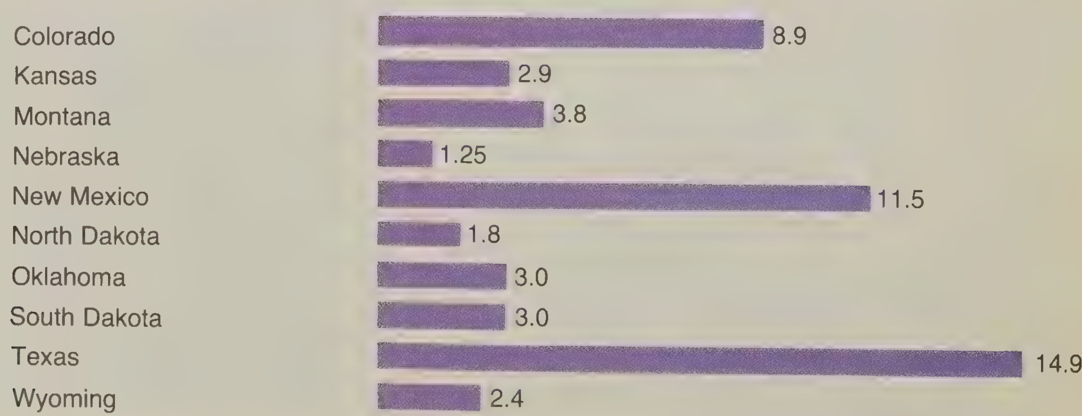
While wind erosion can

Counties Eligible Under Great Plains Conservation Program



Wind Erosion on Cropland in Great Plains, 1977

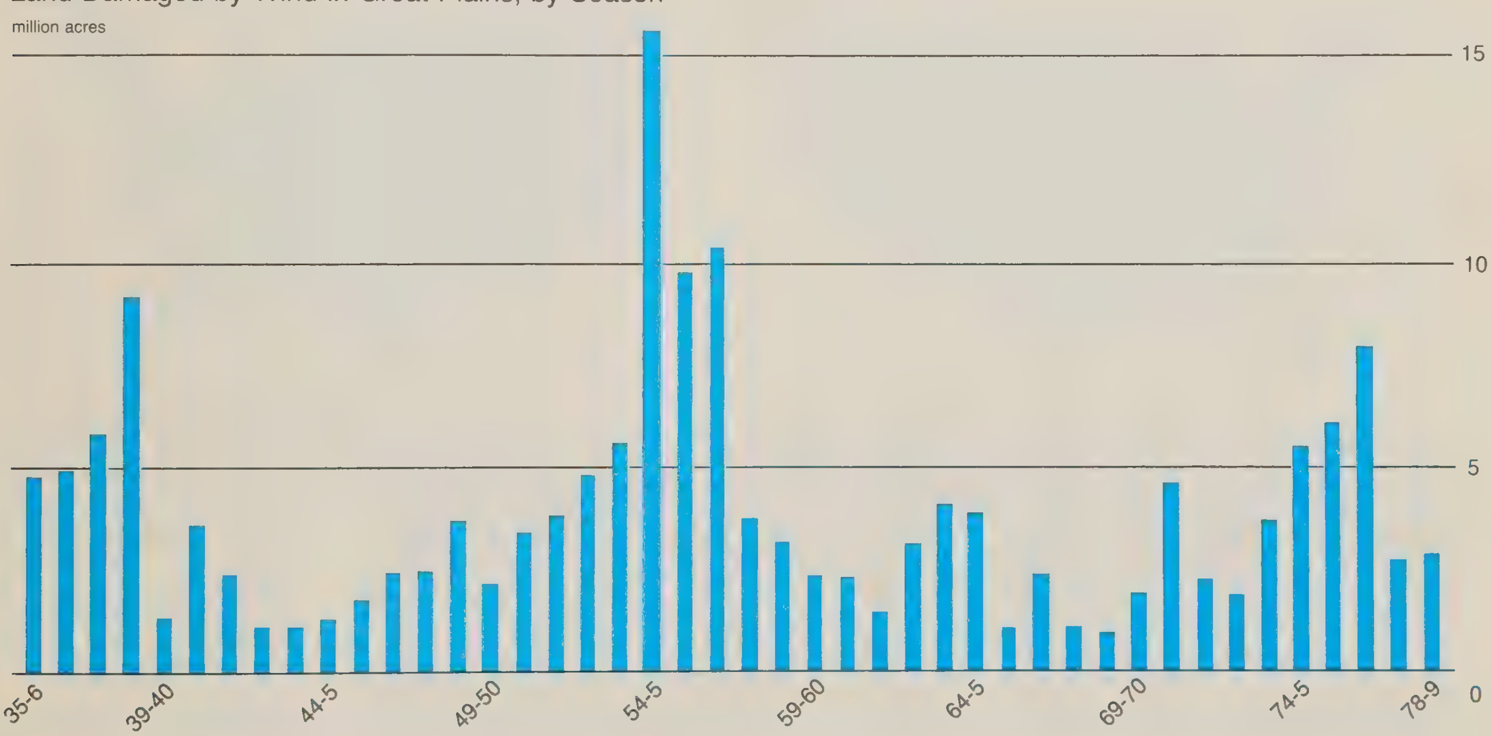
tons/acre



occur in almost every state, it hits hardest and most often in the 10 Great Plains states. In 1977, for instance, Colorado experienced an annual rate of wind erosion of 8.9 tons of soil per acre; New Mexico, 11.5 tons per acre, and Texas, 14.9 tons per acre. Wind erosion is worse in dry years and worse still after successive years of drought, when vegetation that holds the soil in place has died.

The Great Plains Conservation Program places priority on areas subject to severe erosion. Under the voluntary program, millions of acres of hard-to-protect cropland have been returned to grass. Other cropland has been protected from erosion with practices like stripcropping, stubble mulching, and terracing. Range has been improved, and wildlife is returning to the Plains in greater numbers. Each federal dollar invested in the Great Plains program has resulted in nearly $4 of increased agricultural income.

Land Damaged by Wind in Great Plains, by Season



Note: Data for period 1943-44 through 1952-53 were obtained from reports of the Great Plains Council. All other data were obtained from SCS reports. (The number of counties reporting may vary from year to year.)

Wind strips on cropland near Great Falls, Montana, run at right angles to prevailing winds and help reduce soil blowing.

The Nation's nonfederal forest lands . . .more management needed

America's 370 million acres of nonfederal forest land are mostly in the eastern United States, with only 17 percent in the West, where so many of the National Forests are located. About 74 percent of the commercial nonfederal forest is owned by individuals and partners, including farmers; 18 percent by industry, and 8 percent by state, county, and municipal governments.

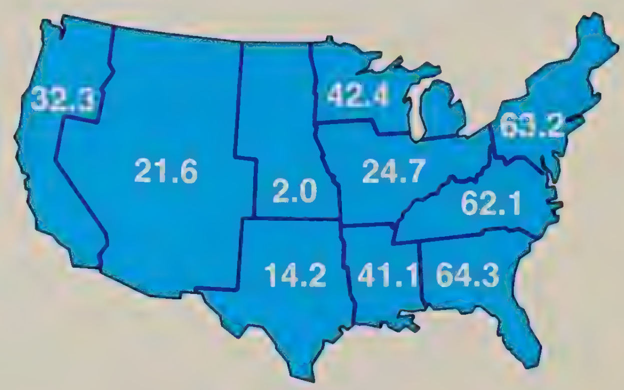
Nonfederal forest land supplies more than 57 percent of the growing stock in the Nation, accounting for more than 82 percent of the hardwood inventory and 43 percent of the softwood.

Net annual growth per acre of trees on farms and other private land has increased dramatically during the past 25 years, but there is still room for improvement through better forest management. It is estimated that farm owners are producing at only 63 percent of potential and that the timber industry is producing at 68 percent of potential.

Nonfederal Forest Land in Each Region

millions of acres

Pacific 32.3	Corn Belt 24.7
Mountain 21.6	Delta States 41.1
Northern Plains 2.0	Northeast 63.2
Southern Plains 14.2	Appalachian 62.1
Lake States 42.4	Southeast 64.3



What Grows on Nonfederal Forest Lands?

North	South	Rocky Mountains and Pacific Coast
White-red-jack pine	Longleaf-slash pine	Douglas fir
Spruce-fir	Loblolly-shortleaf pine-oak-pine	Ponderosa pine
Loblolly-shortleaf pine	Oak-hickory	Western white pine
Oak-pine	Oak-gum-cypress	Fir-spruce
Oak-hickory	Elm-ash-cottonwood	Hemlock-sitka-spruce
Oak-gum-cypress		Larch
Elm-ash-cottonwood		Lodgepole pine
Maple-beech-birch		Pinyon-juniper
Aspen-birch		Chaparral-mountain shrub
		Redwood

More than 60 million acres of nonfederal forest land are being grazed by livestock. On grazed land, sheet and rill erosion is significantly higher than on forest land that is not grazed—nearly 4 tons per acre per year of soil loss vs. 0.6 ton per acre. Also contributing to soil erosion on forest land are gullies, logging roads, ski trails, and streambanks.

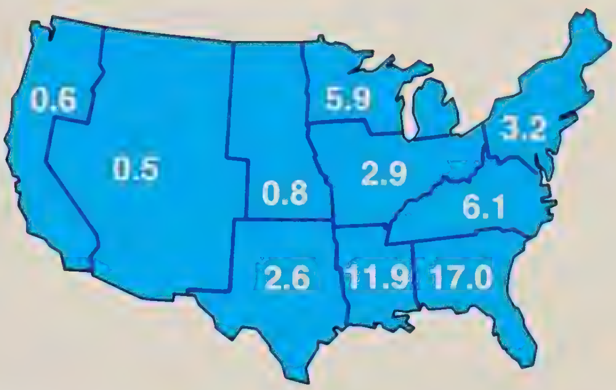
Nonfederal forest land occupies 51 million acres that are prone to flooding, including 37 million acres in the South. Extensive and valuable wetland forests are of two types: oak-gum-cypress in the South and elm-ash-cottonwood in the North.

While most soils in the East and many in the Pacific and Mountain States are suitable for growing trees, the acreage of nonfederal forest land has been decreasing since 1952. Most of the loss occurred as forests were converted to cropland, pasture, and urban uses. The loss of forest to cropland is expected to continue in the 1980's.

Flood-prone Areas of Nonfederal Forest Lands

millions of acres

Pacific 0.6	Corn Belt 2.9
Mountain 0.5	Delta States 11.9
Northern Plains 0.8	Northeast 3.2
Southern Plains 2.6	Appalachian 6.1
Lake States 5.9	Southeast 17.0



Poorly managed forest land has heavy growth of understory and needs thinning to promote maximum timber production.

Trees grow to maturity much faster in well-managed commercial forest.

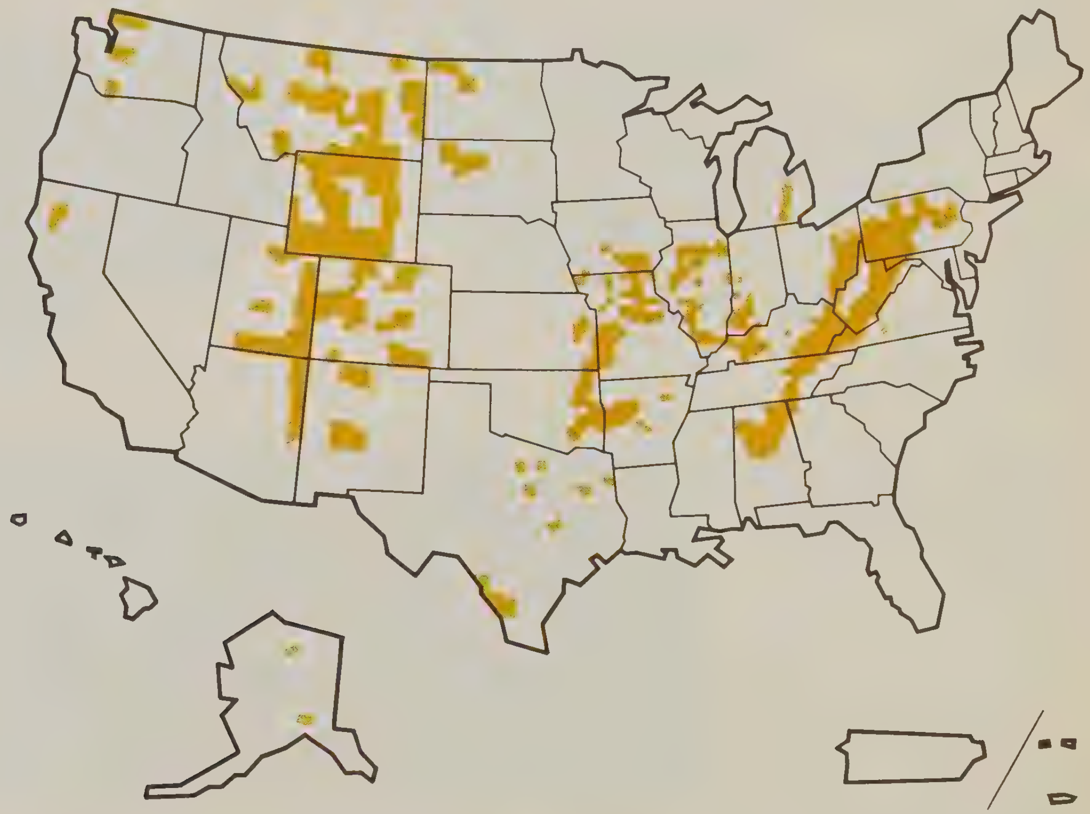
Reclaiming surface-mined land

Surface mining takes place in all states. While the acreage disturbed is but a fraction of our total land area, the impact on the environment is intense and often affects surrounding areas. An example is seepage of mine acid into adjacent streams.

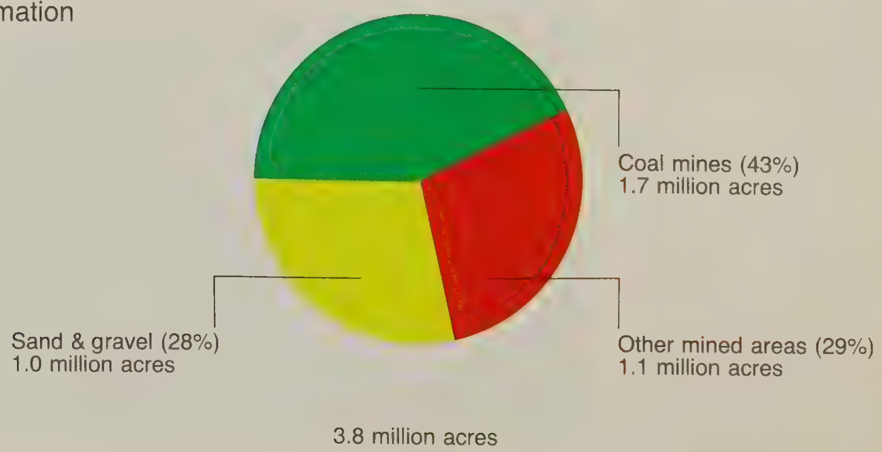
By mid-1977, 5.7 million acres had been disturbed by surface mining in the United States. Of this, about 1.9 million acres had been reclaimed by natural seeding or through efforts of landowners. Reclamation is required by law on another 1.1 million acres not yet reclaimed. There is no legal requirement to reclaim the remaining 2.7 million acres.

With oil and gas prices rising, surface mining of coal seems likely to increase. Strippable coal deposits underlie 10 million acres of United States land – under eastern forests, midwestern croplands, and western range. But much is known about reclaiming such lands successfully, and selected plants will grow well in the harsh environment of mined lands.

Counties with Abandoned Coal Mined Lands



Surface Mined Land in Need of Reclamation



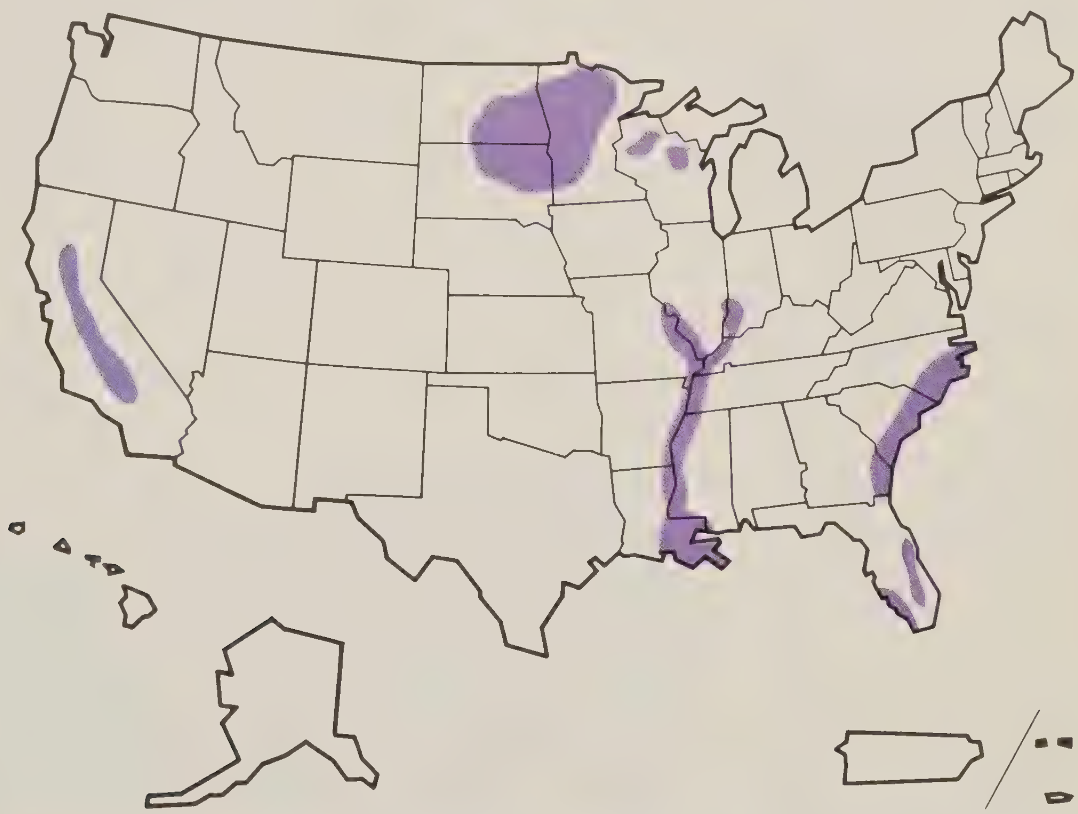
Wetlands:
a threatened natural resource

Wetlands, with their many values, continue to vanish year after year. In 1977, only 70.5 million acres remained in the United States, a decline of 11.5 million acres in 23 years. Recently, the rate of decline has slowed to about 300,000 acres a year, with two-thirds being converted to agriculture.

Not all wet soils are wetlands. Some 270 million acres of nonfederal land consist of wet soils. They make up 25 percent of all cropland and are some of the most productive soils in the world.

But true wetlands should be preserved. Wetlands provide habitat for waterfowl and other birds, for animals, fish and other marine life, and plants, including a number of rare and endangered species. Wetlands reduce flood peaks, increase streamflow in spring, and reduce baseflow in fall. They recharge ground water. They also improve water quality, reducing sediment yields and removing phosphorus from water.

Where Significant Losses of Wetlands and Bottomland Hardwoods Occur



America's shrinking wetlands need to be preserved as habitat for wildfowl and other animal and plant species.

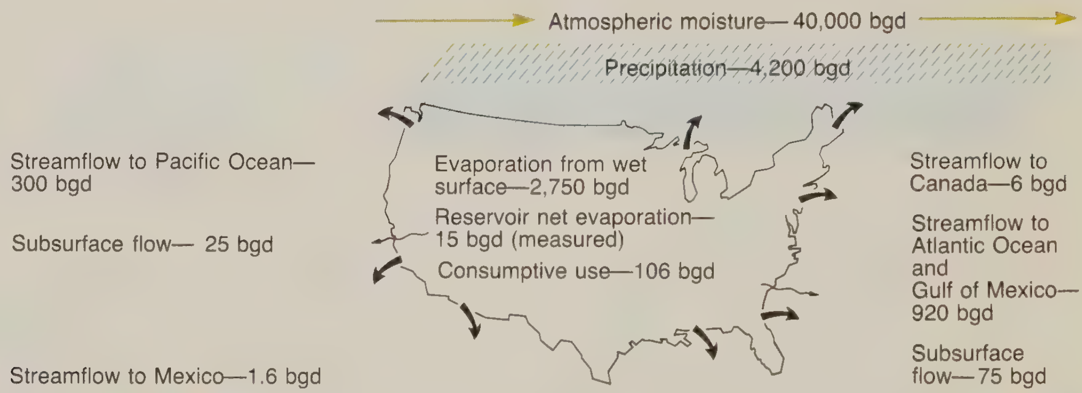
What happens to the rain and snow?

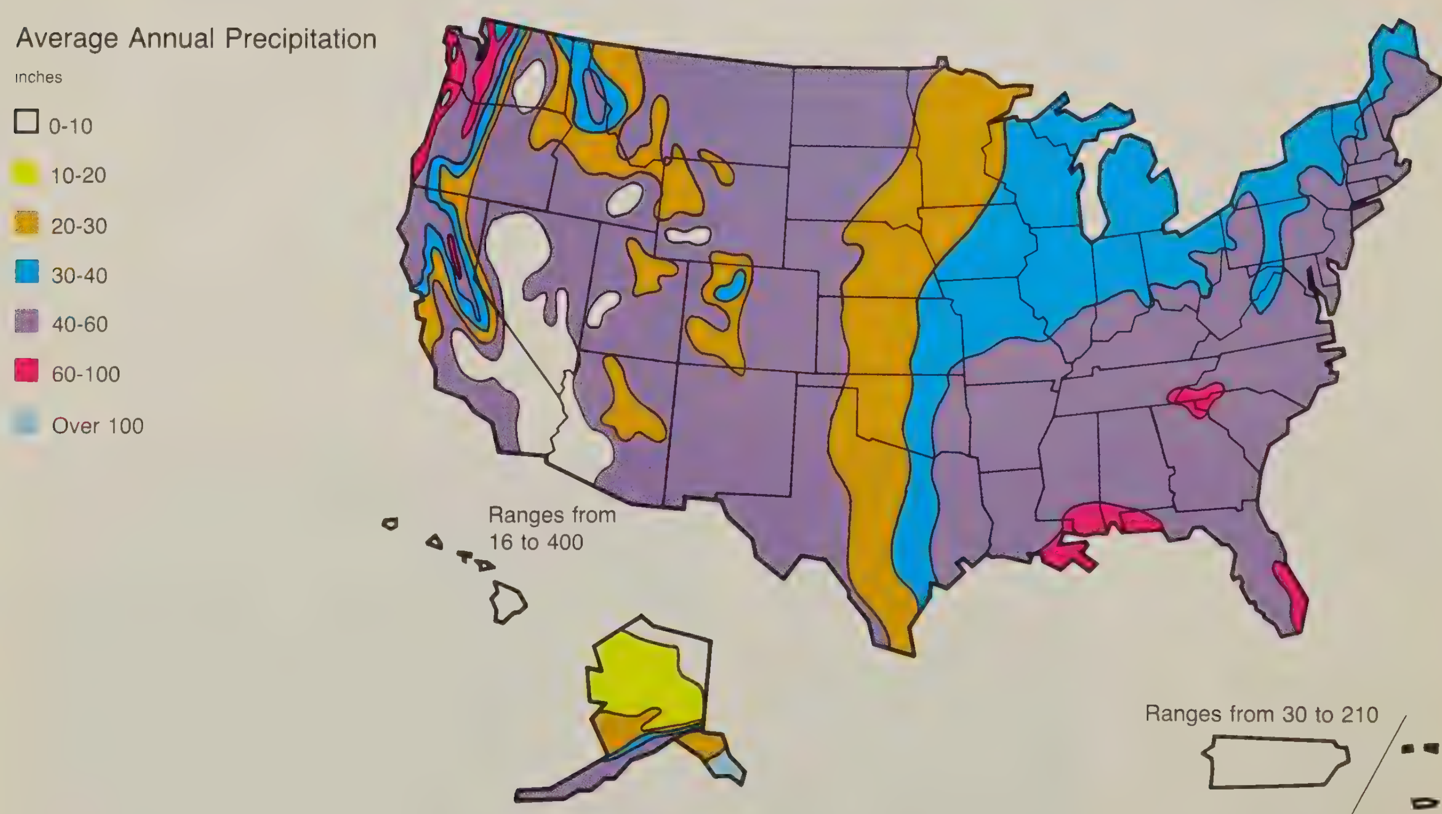
Water continously evaporates into the atmosphere, most of it from the oceans. About 40,000 billion gallons per day (bgd) pass over the United States as water vapor, even in times of drought. Roughly 1 gallon in 10 — 4,200 billion gallons per day — falls to the surface of the conterminous United States. That works out to an average of 30 inches a year, of which 26 inches arrive as rainfall and the rest as snow, sleet, and hail.

But few places receive the average precipitation, which ranges from less than 4 inches a year in the Great Basin to more than 200 inches a year along the Pacific Northwest coast.

More than two-thirds of the precipitation returns to the atmosphere, but 9 inches (1,300 bgd) either soaks down to the ground-water table or runs into surface water supplies, where it eventually moves to the ocean. Only a fraction — 106 bgd — is consumed.

What Happens to the Precipitation?





U.S. DEPARTMENT OF AGRICULTURE

Washington, D.C. 20250

America's Soil and Water: Condition and Trends

E R R A T U M

The map on page 20 showing average annual precipitation is partially in error. The large unbroken area of western United States shown in purple--that lies between the very narrow strip shown in gold on the west and the broad gold strip that runs from Canada to the Gulf of Mexico -- should have been shown in light yellow, indicating annual precipitation of 10 to 20 inches.

Agriculture . . . biggest water user

Agriculture is far and away the Nation's biggest water consumer, accounting for about 83 percent of total water use. Like other water consumers, agriculture intends to use more water each year, although this may not be possible.

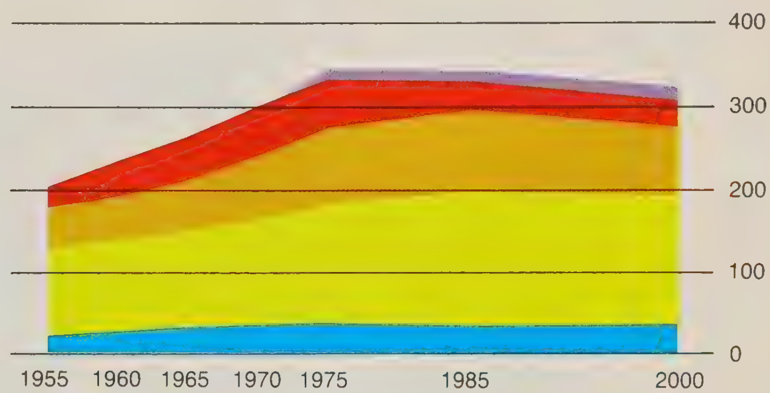
During normalized year "1975" (which does not represent actual 1975 water use), some 339 billion gallons per day (bgd) of freshwater were withdrawn from ground and surface water sources for minicipal and household use, manufacturing, irrigation, mining, electric power generation, and other purposes. Of the 339 bgd, more than two-thirds — 232 bgd — were returned to surface water. The remaining 106 bgd were consumed mostly by application to irrigated crops.

Several water uses do not affect supplies. Lakes, wetlands, and rivers, for instance, provide habitat for fish and wildlife. They also provide water for navigation and recreation.

Freshwater withdrawals, by use

billion gallons per day

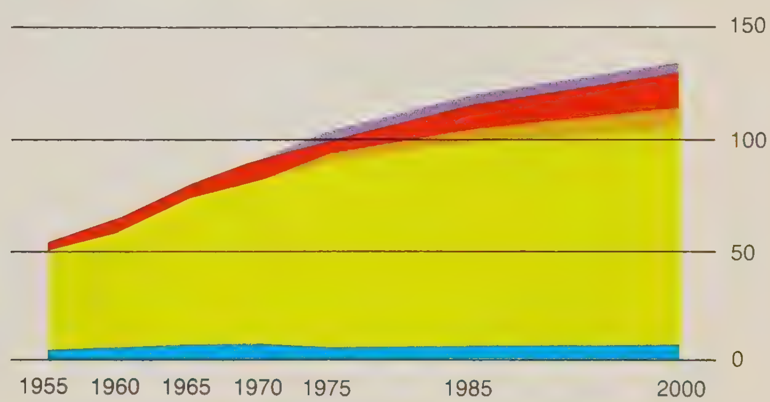
- Domestic and Commercial
- Agriculture
- Steam Electric Generation
- Manufacturing and Minerals
- Public Lands and Other



Freshwater consumption, by use

billion gallons per day

See key above



Irrigator near La Junta, Colorado, flips flexible pipes from elevated irrigation ditch into furrows to water crops.

How experts look at water problems

When water resource planners look at a map of the United States, they do not see state and county boundaries, but river basins and watersheds. The drainage basins of major rivers, or of major groups of rivers, form water resource regions.

Each water resource region, like the basin of the Missouri River, is made up of the drainage basins, or watersheds, of smaller tributaries, and these are designated as subregions. Each subregion, in turn, contains still smaller watersheds, from which water drains toward a single channel. Each watershed contains anywhere from a few thousand to a few hundred thousand acres.

Recognition of the small watershed as a primary unit of resource development led to passage in 1954 of the Watershed and Flood Prevention Act (Public Law 566). Planners and lawmakers decided that if water were managed properly, with flood protection in small upstream watersheds, there would also be less flooding downstream, in the larger river basins.

Water Resource Regions

1 New England Region
2 Mid-Atlantic Region
3 South Atlantic-Gulf Region
4 Great Lakes Region
5 Ohio Region
6 Tennessee Region
7 Upper Mississippi Region
8 Lower Mississippi Region
9 Souris-Red-Rainy Region
10 Missouri Region
11 Arkansas-White-Red Region
12 Texas-Gulf Region
13 Rio Grande Region
14 Upper Colorado Region
15 Lower Colorado Region
16 Great Basin Region
17 Pacific Northwest Region
18 California Region
19 Alaska Region
20 Hawaii Region
21 Caribbean Region

Surface water—not enough for everybody

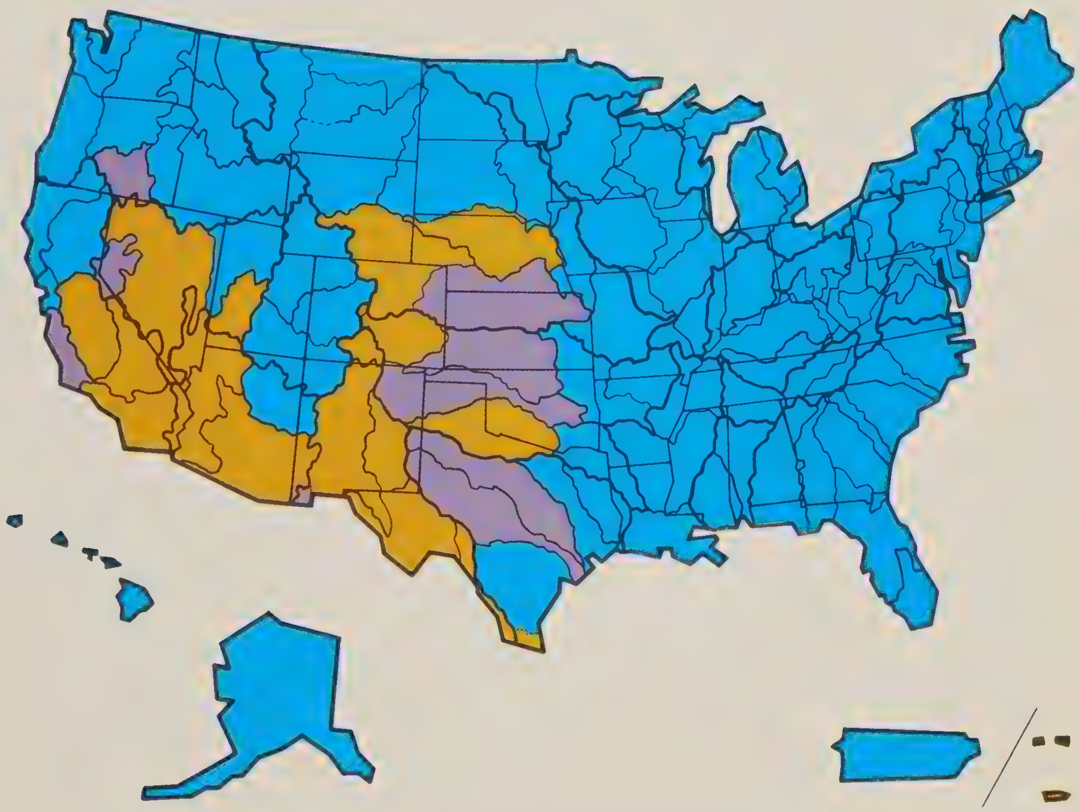
The rivers and streams of the Nation are the major source of our water supply. In much of the country, streamflow is a direct result of rainfall. In the West, however, it is also the result of snowmelt in the mountains, which each spring fills streams and downstream reservoirs. In the Southwest up to 75 percent of the annual runoff occurs during a few weeks in the spring when the snow melts.

In many parts of the West, there is inadequate surface water to meet the demands of agriculture and other users. Inadequate winter snowfall and summer drought can reduce short supplies even more.

Crucial to water supply are dams and reservoirs that store and save water until it is needed. Reservoirs in the United States can store 225 billion gallons of water. There are some 49,000 large reservoirs and more than 2 million small reservoirs in this country, but just 31 of these account for 41 percent of the Nation's total reservoir storage capacity.

Inadequate Surface Water Supply

- 70% depleted in average year
- 70% depleted in dry year
- Less than 70% depleted



Area of Inland Lakes, Rivers, and Streams (excluding the Great Lakes)

More than 2 million acres	1-2 million acres	500,000-1 million acres		Fewer than 500,000 acres	
Florida	California	Alabama	Missouri	Arizona	New Hampshire
Louisiana	Maine	Arkansas	Nebraska	Colorado	New Jersey
Minnesota	Michigan	Georgia	Oregon	Connecticut	New Mexico
North Carolina	Montana	Idaho	South Carolina	Delaware	Ohio
Texas	New York	Illinois	South Dakota	Indiana	Pennsylvania
	North Dakota	Kansas	Tennessee	Iowa	Rhode Island
	Oklahoma	Kentucky	Virginia	Maryland	Vermont
	Utah	Mississippi	Wyoming	Massachusetts	West Virginia
	Washington			Nevada	
	Wisconsin				

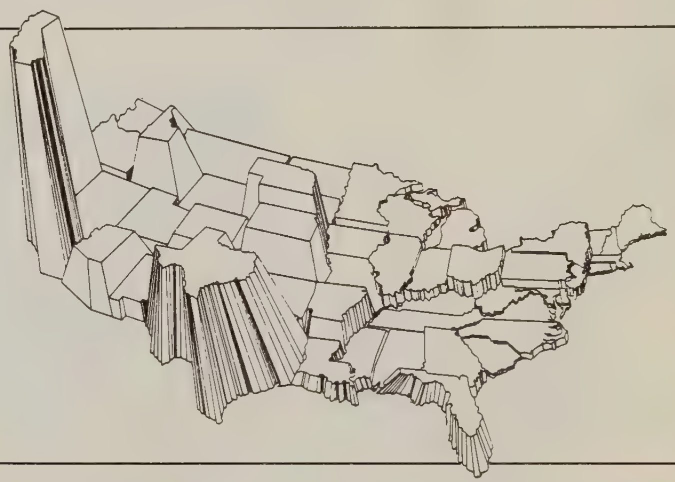
Underground water . . . invisible resource

America's ground-water resources are far greater than the total capacity of all our lakes and reservoirs, including the Great Lakes. The volume is equivalent to about 34 years of surface runoff, and includes vast underground lakes, like the great Ogallala aquifer underlying parts of 8 states in the Great Plains.

In 1975, ground water accounted for nearly one-fourth of the fresh water consumed in the United States, with agriculture using about half. It is, however, replenished slowly. An average of 3 inches of the water that soaks into the ground each year passes beyond the soil moisture zone and recharges ground-water supplies.

Heaviest ground-water withdrawals take place in California, which draws 19 billion gallons per day, and in Texas, which takes 11 billion gallons per day. Idaho, Nebraska, Kansas, Arizona, and Florida also are big users.

Ground-Water Withdrawals, 1975



Ground-Water Resources

Watercourse related aquifers

Extensive aquifers that yield more than 50 gallons per minute of freshwater

Less extensive aquifers having smaller yields

Irrigation is still on the rise

Despite water shortages in some areas, irrigation is on the increase. In 1958, only 37 million farm acres were irrigated. By 1967, the figure was up to 44 million, and by 1977, according to definitions used in the National Resource Inventories, the total was 58 million acres. The rate of change to irrigation accelerated to 1.4 million acres a year during the last decade.

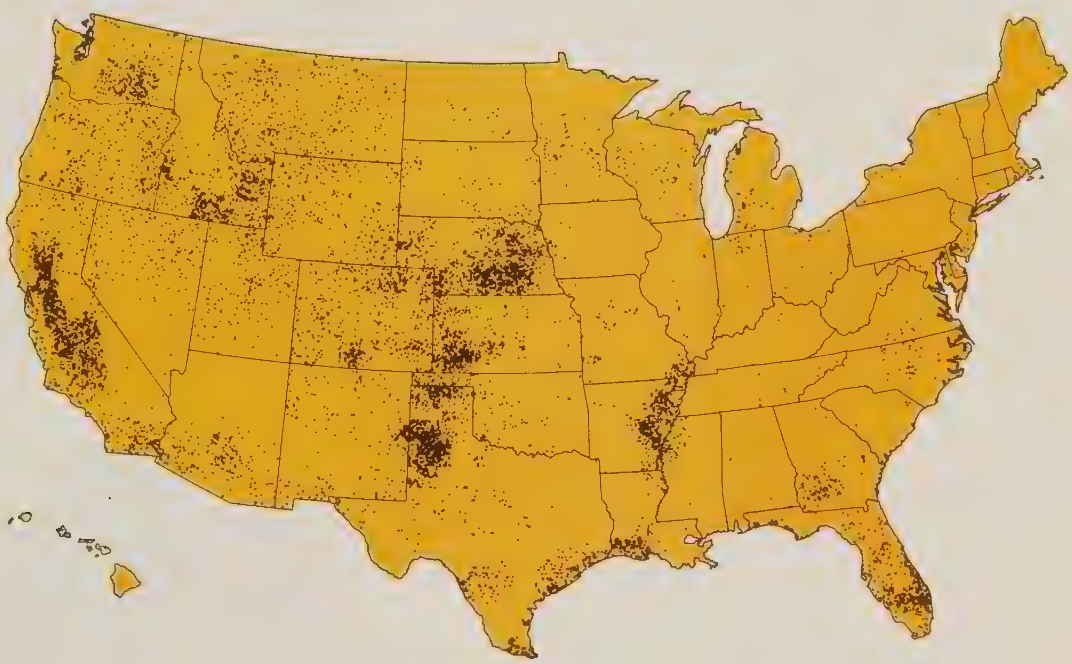
In many parts of the West, crops can't be grown without irrigation. In sections of the Great Plains, irrigated farming replaced dryland farming with invention of the center-pivot sprinkler, which is responsible for those half-mile circles of green seen from the air. Now the trend toward more irrigation is accelerating in humid areas, like southern Georgia and the Gulf Coast, where crops may need supplementary water in late summer.

Three-fifths of irrigated acres use gravity systems; another 32 percent are irrigated under pressure, and 5 percent use both.

Irrigated Acreage: 1977

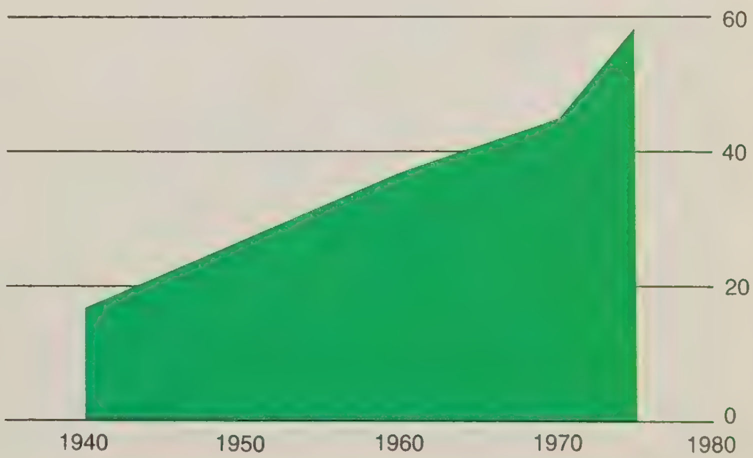
Total for United States is
58 million acres
Data for Alaska not available

1 dot = 8,000 acres



Increase in Irrigated Land

million acres



Irrigation water must be conserved

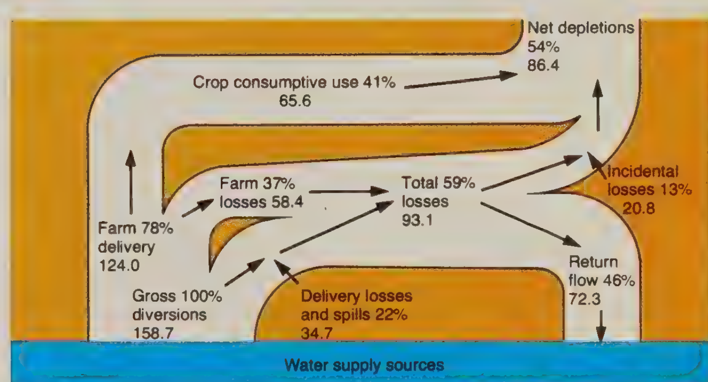
The "plumbing" diagram below tells a story. During normalized year "1975," 158.7 billion gallons per day (bgd) of freshwater was diverted from streams, rivers, and reservoirs for irrigation, most of it in the West.

About 41 percent of the water diverted — 65.6 bgd — was consumed by the crop, most of it moving later into the atmosphere through evapotranspiration. Another 93.1 bgd was lost or spilled, either during delivery of the water to the farm or after it got there. Of this amount, 72.3 bgd was returned to the source. About 20.8 bgd was neither returned nor used by the crop.

Conveyance systems for irrigation water average 78 percent efficiency and onfarm irrigation systems average only 53 percent efficiency. Today's practices leave much room for improvement, both in regulating the timing and amount of water delivered to the plant and in preventing water loss during delivery.

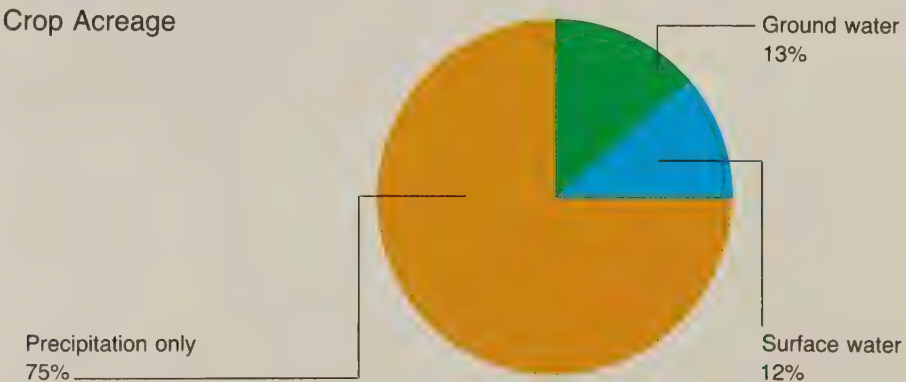
Irrigation Water Budget

Percent of diversions—billion gallons per day



Water Source for Western Crop Acreage

Data are for 17 Western States, 1977.



Acres Irrigated with Pumped Water by Type of Energy Used

million acres

1977 data

Some wells won't last forever

A considerable amount of ground water being withdrawn for irrigation is not renewable. It has accumulated over many thousands of years. In some areas, water is being withdrawn with almost no recharge taking place. This so-called "ground-water mining" is depleting the Nation's water supplies at the rate of 21 billion gallons per day.

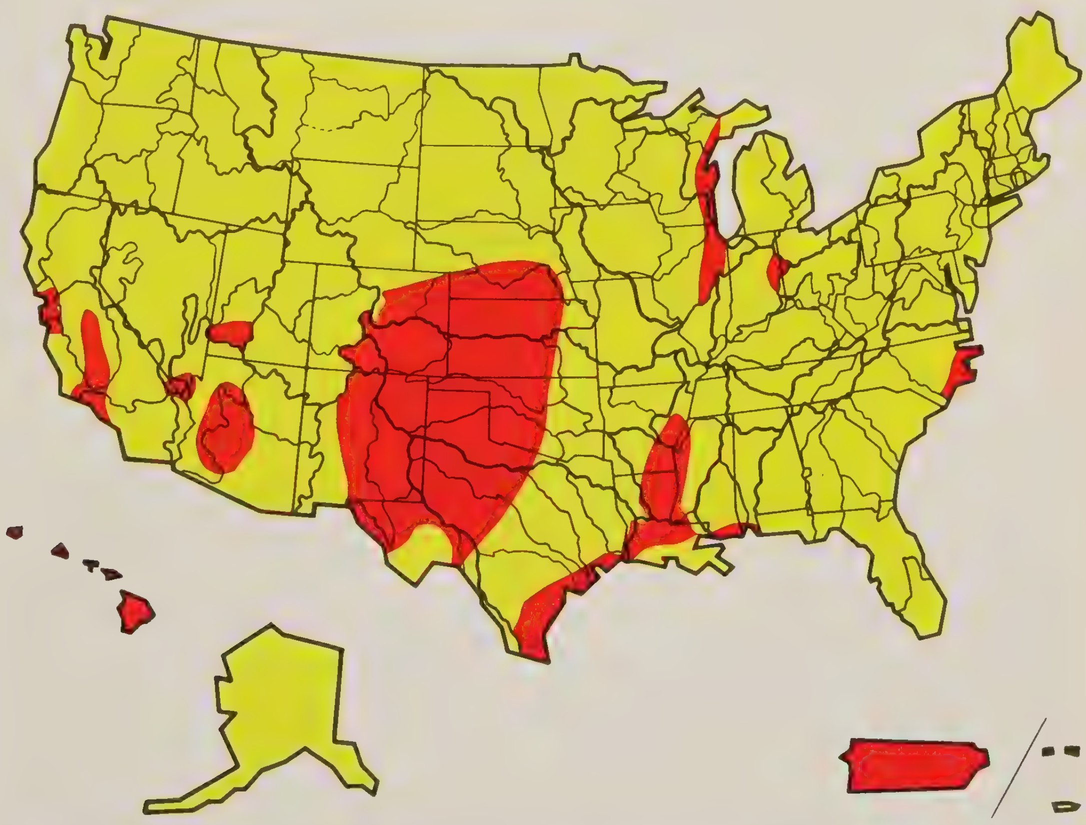
The most serious depletion is in the High Plains area extending from Texas to Nebraska and in Arizona and California. In central Arizona, ground-water levels are falling 7 to 10 feet a year.

More than half the Nation's ground-water overdraft is taking place in the High Plains. Texas A&M University reports that irrigation in the Panhandle will begin a severe decline by 1985 without supplemental water from the outside, and some Texas farmers already have had to cut back.

Ground-water Overdrafts

Significant ground-water overdraft

Problem not considered major



Irrigation well in Arizona pumps at rate of 1,500 gallons per minute. Water table in much of state is falling.

Flood tolls expected to rise . . .

The good news is that 1.3 billion acres of nonfederal land are not prone to flooding. The bad news is that damages are expected to increase in the years ahead on the 175 million acres of land that *are* flood-prone. (A flood-prone area is land adjoining rivers, streams, or lakes where there is a 1 percent chance of flooding in any given year.) Forty-eight million acres of flood-prone land are cropland, 106 million are pasture, range, and forest, and 21 million are other land, including built-up areas.

Twenty-one thousand communities are subject to floods, including 6,000 towns or cities with populations exceeding 2,500. In 1975, the potential damage from floods was $3.4 billion, expressed in 1975 dollars. Because both the number and real value of buildings and their contents are increasing, flood damages also are on the increase.

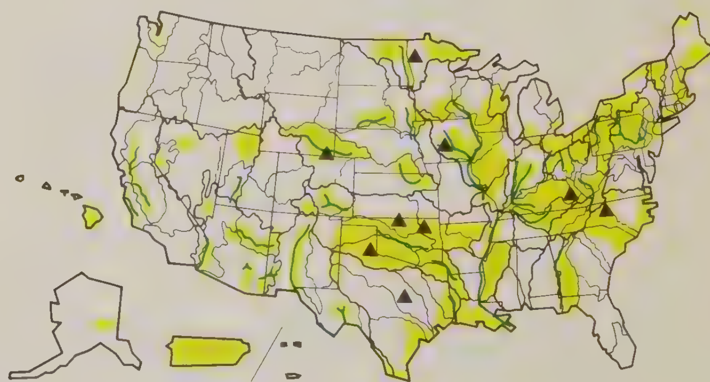
Flooding Problems as Identified by Federal and State/Regional Study Teams

Flooding causes major damage to agricultural, urban, and other developments

Problem not considered major

Major streams and tributaries with periodic overbank flooding

▲ Inadequate upstream watershed management



Flood Plain Use on Nonfederal Lands

Land Use	Acres (millions)	Percent
Cropland	48.2	27
Pastureland and Native Pasture	19.8	11
Rangeland	34.7	21
Forest Land	51.6	30
Other Land	20.7	11
Total	175.0	100

Upstream flood damages

million dollars

Roads, bridges, other damages

Urban

Cropland, pastureland

but upstream protection can help

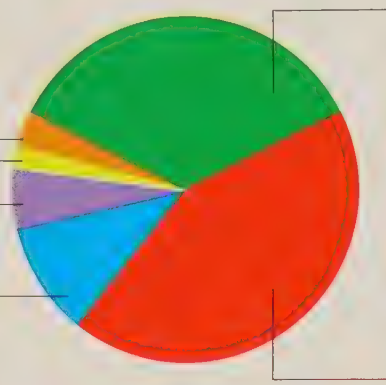
One answer for many communities to upstream floods lies in small watershed projects. Such projects, which are limited by law to watersheds of 250,000 acres or less, employ a combination of conservation land treatment, floodwater retarding structures, and nonstructural means to lessen the effects of unusually heavy rainstorms.

In an unprotected watershed, stormwater rushes down sloping fields, filling streams beyond their capacity. If the floodwater can be slowed and allowed to penetrate the soil, as it does on terraced cropland, pasture, or forest land, upstream floods may be avoided. Or the water may be stored behind an earthen dam and released slowly later, when the storm has ended and the waters have subsided.

These are the features of local watershed projects developed under Public Law 566, with local initiative and federal financial and technical assistance. Of 1,224 P.L. 566 projects approved, 543 are completed or nearing completion.

Status of 1,224 Small Watershed Projects (Public Law 566), as of February 1, 1980

*Includes 530 projects complete all respects.



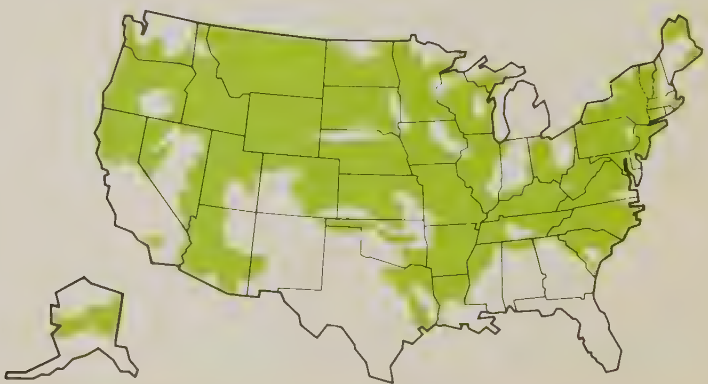
Multipurpose watershed dam and impoundment in North Dakota provides flood protection and recreation for local people.

Sediment is No. 1 pollutant by volume

There are two major types of water pollution: (1) *point source,* in which pollutants enter the water at a specific place, as when toxic wastes from a factory flow from a pipe into a stream, and (2) *nonpoint source,* which is the result of storm runoff from the land. The runoff may carry with it particles of soil, organic wastes, and various chemicals applied to the land. Return irrigation flow is also classified as coming from a nonpoint source.

Agriculture is the most widespread cause of nonpoint source pollution, and the biggest agricultural pollutant is sediment. Sediment, in the form of suspended solids in waterways, screens out sunlight and inhibits the growth of aquatic plants and habitat. Sediment also settles to the stream bottom to form oxygen-demanding sludge. Erosion from cropland contributes nearly half the total sediment. Other culprits are mining, construction, and silviculture.

River Basins Polluted by Suspended Solids



Soil washing from unprotected fields may enter streams and rivers as sediment, a major pollutant of streams, rivers, and reservoirs.

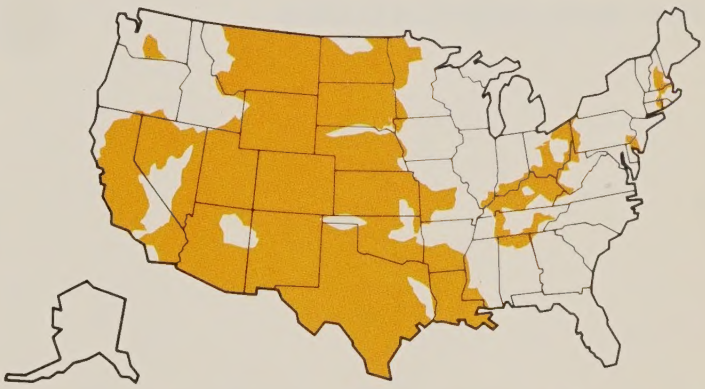
Salts and nutrients also pollute water

Salinity is a common term for concentration of dissolved minerals and solids in water. Salinity can corrode metals, damage crops, and make drinking water unpalatable. Abrupt changes in salinity levels may be lethal to aquatic life.

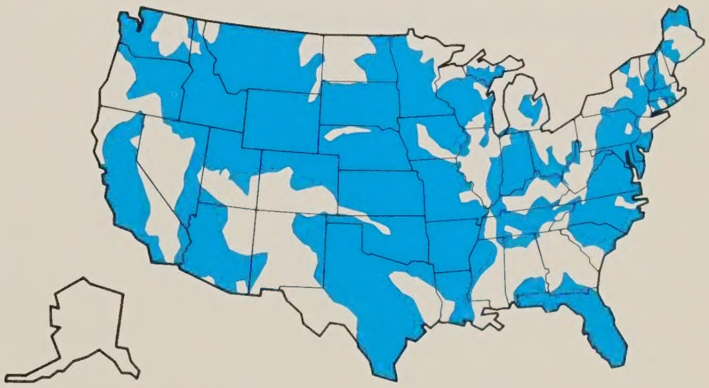
Salinity may result from intrusions of seawater. It also comes from streams and rivers passing over mineral deposits and from irrigation water passing through mineral-laden soil. Since salinity is present in some 20 percent of the soils in the West, improved use of irrigation water can significantly reduce salinity levels of salt-laden streams.

Plant nutrients, including nitrogen and phosphorus, can be transported by sediment and storm runoff into waterways. Nutrients also can come from animal and human wastes, including feedlots and septic tank drainage. Too many nutrients in water can overstimulate aquatic growth, including weeds and algae, reduce the dissolved oxygen available for fish, and make water unsuitable for recreation.

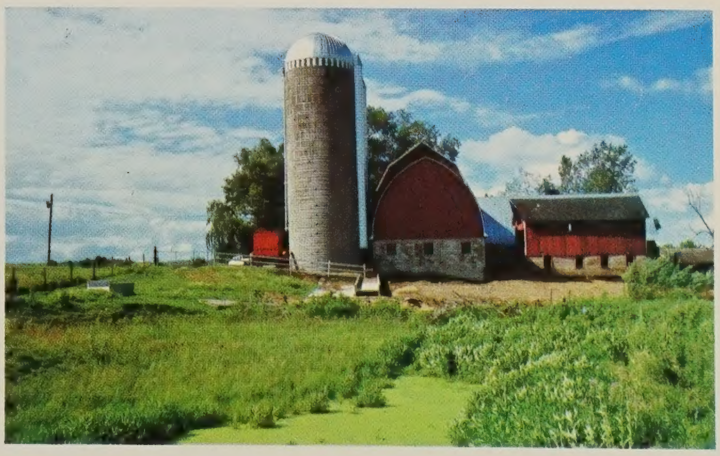
River Basins Polluted by Dissolved Solids



River Basins Polluted by Nutrients



Excess of nutrients entering ponds and lakes can result in eutrophication, or over-fertilization, producing undesirable algae growth.

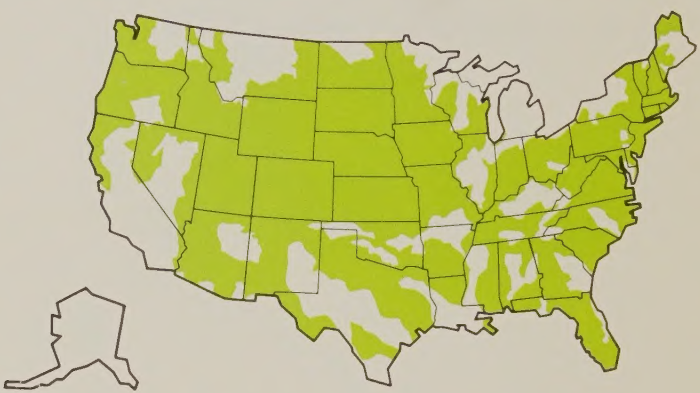


Bacteria and pesticides . . . still a water problem

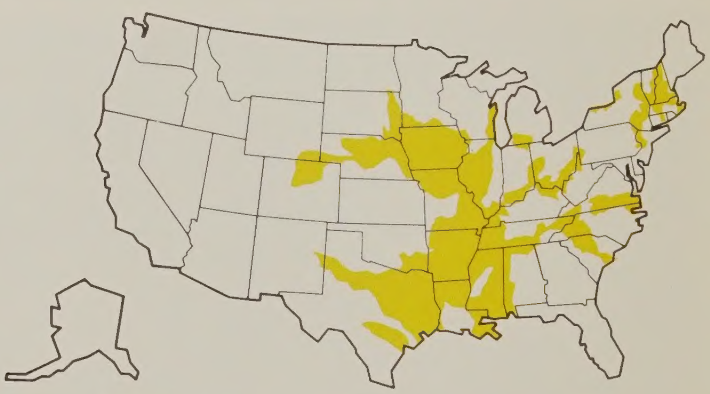
Bacteria, fungi, and viruses that cause disease in plants, animals, and humans may be present in polluted streams. Water-borne diseases include typhoid fever, hepatitis, and encephalitis. Nonpoint sources of bacteria include sewer overflows, septic fields, farm and feedlot runoff, suburban runoff, where pets pose a problem, and migrating waterfowl, which may congregate in large numbers on lakes and reservoirs. Mosquitoes and other insect vectors of disease breed profusely in polluted waters.

Chemical compounds used to kill pests may become toxic pollutants. Certain pesticides can be dangerous to animal life because they are persistent and concentrations build up in the food chain. Since 1966, however, concentrations in water of chlorinated hydrocarbons like DDT have declined, and there is evidence that diet intake of such pesticides has dropped substantially. The amount of pesticide that washes off the land during a crop year is generally less than 5 percent.

River Basins Polluted by Bacteria



River Basins Polluted by Pesticides



Disease bacteria and viruses can get into waterways in several ways, but animal wastes are a major source. Farm animals should be kept out of streams.